Bulletin 322 January, 1931

Connecticut Agricultural Experiment Station

REPORT OF THE DIRECTOR

FOR THE YEAR ENDING OCTOBER 31, 1930

New Haven, Connecticut

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

As of October 31, 1930

BOARD OF CONTROL

His Excellency, Governor John H. Trumbull, *ex-officio, President*

Elijah Rogers, *Vice-President* ..... Southington
George A Hopson, *Secretary* ..... Mount Carmel
William L. Slate, *Director and Treasurer* ..... New Haven
Joseph W. Alsop ..... Avon
Edward C. Schneider ..... Middletown
Francis F. Lincoln ..... Cheshire
S. McLean Buckingham ..... Watertown

STAFF

E. H. Jenkins, Ph.D., *Director Emeritus.*

Administration.
Wm. L. Slate, B.Sc., *Director and Treasurer.*
Miss L. M. Brautlecht, *Bookkeeper and Librarian.*
Miss Dorothy Amrine, B.Litt., *Editor.*
G. E. Graham, *In Charge of Buildings and Grounds.*

Analytical Chemistry.
E. M. Bailey, Ph.D., *Chemist in Charge.*
C. E. Shepard, Owen L. Nolan, Harry J. Fisher, A.B., W. T. Mathis, David C. Walden, B.S. — *Assistant Chemists.*
Miss Harriet C. Yale, *General Assistant.*
Frank C. Sheldon, *Laboratory Assistant.*
V. L. Churchill, *Sampling Agent.*
Mrs. A. B. Vosburgh, *Secretary.*

Biochemistry.
H. B. Vickery, Ph.D., *Biochemist in Charge.*
George W. Pucher, Ph.D., *Assistant Biochemist.*
Mrs. Helen Cannon Cronin, B.S., *Dietitian.*

Botany.
G. P. Clinton, Sc.D., *Botanist in Charge.*
E. M. Stoddard, B.S., *Pomologist.*
Miss Florence A. McCormick, Ph.D., *Pathologist.*
A. A. Dunlap, Ph.D., *Assistant Mycologist.*
A. D. McDonnell, *General Assistant.*
Mrs. W. W. Kelsey, *Secretary.*

Entomology.
W. E. Britton, Ph.D., D.Sc., *Entomologist in Charge, State Entomologist.*
B. H. Walden, B.Agr., M. P. Zappe, B.S., Philip Garman, Ph.D., Roger B. Friend, Ph.D. — *Assistant Entomologists.*
John T. Ashworth, *Deputy in Charge of Gipsy Moth Work.*
R. C. Botsford, *Deputy in Charge of Mosquito Elimination.*
J. P. Johnson, B.S., *Deputy in Charge of Asiatic and Japanese Beetle Quarantines.*
Mrs. Gladys Brooke, B.A., *Secretary.*

Forestry.
Walter O. Filley, *Forester in Charge.*
H. W. Hicock, M.F., *Assistant Forester.*
J. E. Riley, Jr., M.F., *In Charge of Blister Rust Control.*
Miss Pauline A. Merchant, *Secretary.*

Plant Breeding.
Donald F. Jones, Sc.D., *Geneticist in Charge.*
W. R. Singleton, Sc.D., *Assistant Geneticist.*
Lawrence C. Curtis, B.S., *Assistant.*
Mrs. Catherine R. Miller, M.A., *Secretary.*

Soils.
M. F. Morgan, M.S., *Agronomist in Charge.*
H. G. M. Jacobson, M.S., *Assistant Agronomist.*
Herbert A. Lunt, Ph.D., *Assistant in Forest Soils.*
Dwight B. Downs, *General Assistant.*

Tobacco Substation at Windsor.
Paul J. Anderson, Ph.D., *Pathologist in Charge.*
T. R. Swanback, M.S., *Agronomist.*
O. E. Street, M.S., *Plant Physiologist.*
Miss Dorothy Lenard, *Secretary.*

THE TUTTLE, MOREHOUSE & TAYLOR COMPANY, NEW HAVEN, CONN.

REPORT OF THE DIRECTOR

FOR THE

YEAR ENDING OCTOBER 31, 1930

To the Board of Control of the Connecticut Agricultural Experiment Station:

A formal and complete report of your Board to the Governor of the State is made annually. However, this is not completed until late in the year, and moreover, is not generally seen by the public. For the past 10 years it has been the custom to give a brief summary of the Station's work for the year, in a form which can be read by all who are interested.

While much of the Station's work is fundamental and essential to the teaching of the Agricultural College and the Extension Service, it is done quietly and does not attract public notice, so that the needs of the Station and the importance of its work may be easily overlooked. In addition to its work in agricultural research, this Station has become during the 55 years of its life an agency of public service, primarily agricultural, but serving in large measure all the citizens of the State.

Of first importance is the congestion in the laboratories, a condition that is seriously hampering every phase of the work with which the Station is charged. The last addition to our plant was made in 1910, when a wing was added to the Johnson (main) laboratory. By 1919, the work and staff had so increased that the General Assembly appropriated $100,000 for the erection of a laboratory on the Station grounds, to be used jointly by the Station and the State Board of Health. Unfortunately for us, before this building could be started, it was decided that the Board of Health should remove to Hartford. Therefore this appropriation could not be used and it reverted to the State Treasury.

Year by year the laboratories have become more crowded. In 1928, a careful survey of the needs was made and a request for a new laboratory building was included in the estimates presented to the General Assembly, but the item was not appropriated. By vote of your Board an item of $50,000 has again been included in the estimates for 1931-1933.

A brief statement of the growth of the Station and its work

during these 20 years will serve to show clearly how acute is the need for added space.

	1910 (Date of last new building)	1930
Number on Staff	29	62[1]
Number of projects	40	101
Annual report	400 pages	1,000 pages
Income of the Station	$56,000	$200,000[2]
Value of the State's agricultural products	$37,000.000	$75,000,000

[1] Does not include those at Windsor and other outlying posts.
[2] Does not include funds appropriated for tobacco investigations and gipsy moth control.

Over-crowded conditions are serious in any situation—tenements, offices, or shops—but for scientific experimental work it is extremely poor economy. Such work is not routine nor manual. It requires highly trained men who do their best work undisturbed in a quiet, studious atmosphere. They must have space to set up complicated apparatus, under controlled conditions, and this must be free from interference.

At present in our Entomology Department four scientists are trying to work in a room 21 by 27 feet, which also houses two stenographers and the insect collections. The room is a thoroughfare and work room for several others. Dr. Britton's small office adjoining must serve as the department's library to which all other workers must come frequently for reference books. The parasite breeding work is being carried on in four places, none suitable.

A similar situation exists in the other departments. The Biochemical laboratory, for instance, where research on the plant proteins and nutrition has taught us so much of the fundamentals of human and animal nutrition, is now working under crowded conditions that would be considered almost impossible in any other research institution.

The sum mentioned, $50,000, is not a large item and it might well be asked whether this is sufficient to provide the space needed. The explanation is unusual: the Station has never charged to its income from the Fertilizer and Feed Analysis fees, any more than the actual cost of doing this work. Although the expense now about equals the income, during the past ten years we have been able to accumulate a surplus, which can be applied to the cost of a new laboratory.

The Station asks, because it urgently needs, more room for its work. One might inquire, "What have you done? What are you doing?" In the pages that follow a survey of the Station's activities is presented. However, no such brief statement can present a complete picture. The benefits we are reaping to-day and hope to harvest to-morrow are often the result of many years of careful, painstaking research.

SERVICE WORK IN ANALYTICAL CHEMISTRY

Fertilizers

Chemical analysis of the fertilizers sold in Connecticut showed that 92 per cent substantially met or exceeded their guaranties, a higher percentage than in any year of the last ten. Only three per cent revealed approximate commercial deficiencies greater than $1.00 a ton. More than 1,000 analyses were made by the station chemists, of which 498 were of the official station samples.

For ten years the data on commercial deficiencies has been compiled to show the cumulative record. These figures show that, for the manufacturers listed, 94 per cent of the samples analyzed measured up to their declarations or came within $1.00 of their computed value. No manufacturer is included in the list unless ten or more of his brands were examined in this period.

Feeds

Of the feeds sold in Connecticut, 85 per cent met the guaranteed analyses under which they were offered. This is a gain over last year when the corresponding percentage was 78. Considering the three individual guaranteed items, protein, fat and fiber, for each sample, there were 1938 guaranties and 117 deficiencies. This means that 94 per cent of these guaranties were met, as compared with 92 per cent last year.

Microscopic examinations have revealed no instance of serious adulteration or contamination with weed seeds or other deleterious materials. In the main the declarations of ingredients have been substantiated by our examinations.

Foods and Drugs

Analyses of 224 different brands of cereal breakfast foods and similar products are listed in the report on foods and drugs, Bulletin 319. Of these, 86 are new examinations supplementary to previous compilations. Station chemists analyzed 1810 samples of foods, drugs and miscellaneous materials, most of them submitted by the State Dairy and Food Commissioner. Ice cream sold in Connecticut last year tested, for the most part, high above the legal standard of eight per cent butter fat. A survey made of places where milk was dispensed by the glass (rather than in bottles, which is the legal requirement) revealed that a considerable portion of the samples were adulterated by skimming.

Drugs examined in 1929 were taken chiefly from stores in smaller towns where drugs may be dispensed by a general mer-

chant, if they are sold in original containers and bear the label of a licensed pharmacist. It was thought that the quality of such drugs might be inferior by reason of deterioration due to less rapid turnover of stock, but the inspection shows that the proportion of drugs found to be below standard is not greater than that observed when inspection is confined to larger dispensing centers.

Babcock Glassware

Only 12 pieces were rejected as inaccurate in the inspection of 2,427 Babcock test bottles and pipettes. All but nine dairy thermometers in a total of 111 were found to be accurate.

Coöperative Activities

Collaboration in tobacco investigations conducted by the Tobacco Substation and the Department of Soils involved analyses of 160 samples by the Department of Analytical Chemistry. The chemists studied analytical methods for fertilizers, foods and drugs proposed by the Association of Official Agricultural Chemists, and occasional analyses and reports were made in coöperation with the Council on Pharmacy and Chemistry of the American Medical Association. Chemists of the department have participated in programs sponsored by the American Oil Chemists and the F. S. Royster Guano Company, involving check analyses of cottonseed meal and fertilizers. Miscellaneous insecticides and fungicides were examined, samples being submitted chiefly by the Department of Entomology.

PROGRESS IN BIOCHEMICAL RESEARCH

Cell Chemistry

The investigation of the tobacco plant has been continued. A study of tobacco seed showed that no nicotine occurs therein but that appreciable amounts of this alkaloid were formed during the development of the sprouts after 12 days' germination. Nicotine is therefore formed during the growth of the embryo from stores of nitrogenous food laid down in the seed. The seed was also found to contain a high proportion, 42 per cent, of oil and appreciable amounts of protein, although very little carbohydrate occurs in it. One of the proteins of the seed was extracted and prepared in crystalline form. A study was also made of the different forms of nitrogen in the sprouts of the seeds and a comparison made between these and the forms of nitrogen in the unsprouted seed.

A method for the determination of the total nitrogen of plant extracts that contain nitrates has been developed and applied to various specimens of tobacco. An investigation of the effect of the presence of nitrates on the conventional method for determining amide nitrogen has been carried out and a modification of the method devised whereby the errors that may arise in the presence of nitric acid are avoided.

A specimen of nicotimine, a rare akaloid that accompanies nicotine in tobacco, has been isolated. Data have been obtained on the variability of the proportion of nitrate in tobacco and the capacity of this plant to store nitrates. A comprehensive investigation of the changes that occur during the curing of tobacco has been initiated. Two journal papers and a contribution to Bulletin 311, the annual report of the Tobacco Substation at Windsor, have been prepared and published. A general paper on the chemistry of green leaf cells has also been published.

Protein Chemistry

An investigation of the basic amino acids of sheep's wool has been published. This was carried out to supplement previous work on human hair, and our studies of proteins of this type have been widely extended during the year. Results have been secured that will be submitted to a journal at a later date. A comprehensive study of the silver compounds of the amino acid cystine has been made which has revealed a new and important reaction of this substance. The results furnish an explanation of certain of the difficulties that had been encountered in conducting analyses of the basic amino acids of proteins and also indicate how these difficulties may be avoided. Studies of individual amino acids have been carried out with the object of preparing specimens of certain rare amino acids and of developing new methods for the separation of these substances from each other. A preliminary chemical study has been made of the proteins of the tobacco seed.

Nutrition

The investigation of the effect of certain inorganic constituents of the diet on the growth of bone has been continued and publication of some of the more striking results will shortly be made. In this work we have enjoyed the benefit of the collaboration of authorities from other institutions, notably Yale University, the Johns Hopkins Medical School, and Vanderbilt University.

A study of the effect of the long continued administration of iodide to rats in quantities equivalent to medicinal doses failed to show harmful results that could be detected. This investigation also revealed the adequacy, with respect to iodine content, of the

inorganic salt mixture that has long been employed in our nutrition studies. A paper on the vitamins of the now widely used salad "green," water-cress, has been published.

Studies of the fundamental characteristics of the basal metabolism of the rat, conducted in coöperation with Dr. F. G. Benedict of the Nutrition Laboratory of the Carnegie Institution of Washington at Boston, have been continued and one paper describing some of the results has appeared.

FIGURE 1. This rat grew to maturity on a diet made up of 98 per cent ground tobacco seed and two per cent of Osborne-Mendel salt mixture IV, together with 10 drops of cod liver oil, which was administered daily to make up the deficiency of the seed in vitamin A. When carefully freed from chaff this seed is therefore a valuable food.

The laboratory has been privileged to coöperate with some of the investigations on tooth development in animals that are being conducted at the Yale School of Medicine.

Preliminary investigations on the nutritive properties of the tobacco seed are nearing completion. Since the seed contains abundance of oil and protein and is free from poisonous alkaloids its possible importance as a food is a matter of interest to Connecticut.

The scope of the investigations of the biochemical laboratory of this Station has been greatly broadened in the past by the generous

financial assistance of the Carnegie Institution of Washington. The Institution has continued its help during the past year by a grant to Professor Mendel and Dr. Vickery.

COMBATING PLANT DISEASES

Virulence of Chestnut Blight Studied

Mature nuts from sprouts and seedlings of the chestnut tree were apparently more common in Connecticut than in any year since the blight appeared. However, this does not mean that the chestnut tree is showing resistance. All of the older generation, that is, the trees living when the fungus first struck, are dead. From some of the stumps sprouts may come up. Then in four or five years they succumb to the disease. Or, a seedling may reach a height of 15 or 20 feet, with a diameter of four or five inches, but it gradually becomes infected with the blight and dies.

Both sprouts and seedlings seem to live longer than they did a few years ago. This is largely because the blight is not so abundant. Many thousand trees have been destroyed, and few sprouts are left to spread infection. As yet no instance of a native chestnut that resists the disease has been found, although occasionally such trees are reported elsewhere.

Chestnut plantations grown to study the fungus show little evidence of the disease, but loss of trees through drought and other unfavorable conditions has been heavy. Plots under observation in naturally wooded areas of Goshen and South Britain seem to be improving.

When experimental trees now growing on the Station grounds are older, they will be inoculated with pure cultures of the fungus in an effort to determine whether virulence is lost when the disease is kept alive artificially for a period of years. The cultures have been growing more than 20 years in the station's botanical laboratory. These will be compared with recently isolated cultures.

Lawn Grass Killed by New Fungus

A fungus heretofore rarely seen in Connecticut spread like an epidemic over lawns and golf courses in the southern part of the state. Lawns recently seeded seemed to be the most susceptible and the bent grasses, especially the creeping bent, appeared to be the most severely attacked.

The disease, which is caused by a species of Helminthosporium, shows as patches of dead grass, characteristically different from those of a more common disease known as "brown patch." The grass is matted down as if it had been saturated with gasolene or

kerosene and under the microscope the dead leaves show black spots.

Spraying with Bordeaux mixture gave beneficial results, although the drought evidently stopped the spread in many cases.

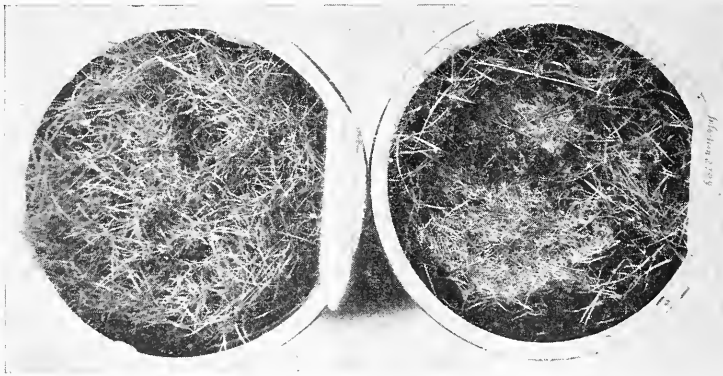

FIGURE 2. On the right is a pot of lawn grass inoculated with the fungus that appeared this summer. The pot on the left is healthy.

Cultures of the fungus were obtained and successful inoculations were made to produce the disease. Control studies were begun and will be continued.

Early Development of Apple Scab

A biological phenomenon unprecedented in Connecticut was observed last spring by the station botanists. The most virulent and most common fungous disease that attacks apples, the apple scab, developed five weeks ahead of time, in late March, rather than in late April. Scab spores capable of producing infection were identified on leaves collected on March 25 under the trees of a Milford orchard. This early development of the spores was not attributed to unseasonable warm weather, but rather to the early fall of leaves the year before. Ordinarily an unusual outbreak of scab would have resulted, but because of the dry season, infection was light on sprayed trees and only average on the unsprayed.

In connection with these studies the asco stage of the apple scab fungus was obtained in culture for the first time in this laboratory. The cultures were grown from single asco spores obtained from apple leaves.

Information on when to spray the trees for scab was supplied to the grower over the telephone spray service maintained by the County Farm Bureaus in coöperation with the Experiment Station. The Station botanists and entomologists study the development of fungous and insect pests and by the aid of special weather

data obtained from the New Haven office of the Weather Bureau are able to advise when to spray. The warnings or bulletins are telephoned to the County Agents, who in turn send them through the state on a previously arranged telephone chain.

Willow Scab Injury Less

The last two years and particularly this year, the willow scab fungus, which was discovered in 1927, has diminished in severity generally over the state. In the village of Norfolk all willows of *Salix alba.* var. *vitellin,* except four sprayed in an experiment, are dead. These treated trees received four applications of Bordeaux mixture or lime sulfur this year as previously and are in better foliage than at any time since the experiment was begun. A few leaves were killed after the wet weather of June, when most of the spray was washed off.

The asco, or mature, stage of the fungus has been obtained in culture for the first time. It has not yet been found in nature. The ascospores seem to be different from those described and pictured by Aderhold, who studied the willow scab fungus in Europe.

Elm Disease Under Investigation

An elm disease found in New Haven is under investigation. It is similar in appearance to the European elm disease, but it is believed that the New Haven fungus is not the same as that common in Europe. Cultures have been obtained, but as yet the identity of the organism has not been surely determined. Inoculations on young elms have caused a slight injury in a few cases and the fungus has been recovered from these.

SEED TESTING UNDER THE NEW LAW

The work of seed testing has almost doubled because of the new statute, which provides that all seeds sold in Connecticut, except those of trees, vegetables and flowers, be labeled as to germination and purity. It is provided that the Station make the analyses on samples collected by the Commissioner of Agriculture, who is charged with administration of the act. Three hundred and twenty samples were submitted, all of which required testing for purity and germination. In addition to this, 232 samples were tested for germination and six for purity as part of the Department's regular work. This is done for individuals who request it.

APPLE SPRAYS TESTED

Apple trees on the Station farm in Mount Carmel were sprayed by the Departments of Entomology and Botany with the main purpose of determining the amount of spray injury from the use of

different materials. Seven different combinations were used with the following results.

(All with 100 gals. of water, and 3 lbs. of arsenate of lead.)

1. Iron sulfate, 10 lbs.; liquid lime sulfur, 3 gals.
   Results unfavorable; russeting bad and finish poor. Least amount of perfect fruit of all treatments.
2. Liquid lime sulfur, 3 gals.
   Better than No. 1, especially in regard to russeting of fruit.
3. Dry lime sulfur, 6 lbs.
   One of the best three treatments.
4. Sulfocide-scalecide.
   Prepink: scalecide, 1 gal., sulfocide, 1½ gals.
   Summer: sulfocide, ½ gal., lead arsenate, 2 lbs., Kayso, 2 lbs.
   Results about the same as No. 3.
5. Oxo-bordeaux, etc.
   Delayed dormant: Oxo-bordeaux, 8 lbs., scalecide, 5 gals.
   Pre-pink: Oxo-bordeaux, 8 lbs.
   Calyx: dry lime sulfur, 6 lbs.
   Summer: Oxo-bordeaux, 8 lbs.
   Good except on Baldwin, where russeting was bad, possibly due to omission of lime as recommended.
6. Hydrated lime, 10 lbs., fish oil, 1 qt.
   Finish good; except for scab on McIntosh, best of all.
7. Calcium sulfide, 16 lbs.
   Not so good as No. 6, but next best for finish and better for scab.
8. Check.
   Worst in regard to insect and fungi (coddling moth, curculio, fruit speck, scab, and sooty blotch), but less fruit russeting than on most of the others.

Little foliage injury was caused by any of the treatments.

CONTROL OF INSECT PESTS

European Corn Borer Found in New Towns

The European corn borer spread widely during the summer of 1930 and is now present in every county of the state. Federal scouts during the summer found 44 additional towns infested, most of which harbor the more dangerous two-generation insect. The one-generation borer has been present for two years in a few towns on the Massachusetts border. It is presumed this is the strain that spread into Hartford and Litchfield Counties.

In 1929, several scattered infestations were discovered in towns

not connected with the quarantined area and fields in nine towns were burned by state and federal workers to destroy corn stubble and other refuse, where the borer might spend the winter. The approximate cost to the state was $2,310.79. Roxbury, Southbury, Bethel and Easton were so successful in their clean-up operations that no borers were found this summer in these towns. Since the corn borer has spread into so large a territory, the Station will undertake little if any burning this year.

According to a new statute that requires owners and managers to destroy cornstalks and stubble in areas quarantined for the corn borer, orders were issued for a "clean-up" in all restricted territory, which extends east of a line drawn roughly from Branford to

FIGURE 3. European corn borer control. A crew burning a cornfield with oil to destroy stubble and weeds, where the borer spends the winter.

Woodstock. In April, state and federal men drove through these quarantined towns, interviewed owners where cornstalks were seen and induced them to sign cards agreeing to carry out the orders. A portion of the card was to be sent to the State Entomologist when the work was completed, and 675 such reports were received. On the whole good coöperation was obtained.

Federal inspectors patrolled 34 highways along the margin of the two-generation area under quarantine from July 16 to October 11. In this time 3,452,939 motor vehicles were stopped and searched and 725 corn borers were found in sweet corn and certain flowers and vegetables.

Mosquito Breeding Places Drained

Ditches to drain several hundred acres of salt marshlands along the shore of Long Island Sound, where the most troublesome species of mosquito breeds, were dug under the supervision of the Station. With work to be done next spring at a cost of $3,000, Old Lyme will complete ditching 1,393 acres of salt marshes, one of the largest areas in the state. The town spent $5,000 this year and residents have reported great reduction in the number of mosquitoes.

This summer and fall 200 acres were ditched in the town of Old Saybrook, and this fall an additional $1,000 was appropriated. Some of the work will be done each year until all the mosquito breeding land is drained. This town has finished 370 acres.

The towns of Groton and Stonington have raised funds to ditch salt marshes and this work will soon be under way. Only seven shore towns have failed to drain all or part of their salt marshes, or to make any provision for it. They are Bridgeport, Stratford, Milford, North Haven, Lyme, Waterford, and New London.

Since such large areas are qualifying under the statute in regard to maintenance of ditches, which is done by the Experiment Station, the present sum allowed is inadequate. A larger appropriation will be needed.

An experiment in control of fresh-water mosquitoes was carried on for the second year in coöperation with the town of New Canaan. At the invitation of the town the Station appointed a deputy to conduct a series of experiments, and to make recommendations. New Canaan is considered a laboratory for the study of the state's inland mosquito problem.

Mexican Bean Beetle Survived Winter

The Mexican bean beetle, whose original home was in the arid Southwest, has not only survived its first New England winter, but has spread further until it is well scattered over Connecticut. The pest was first found in this state in 1929.

Mexican bean beetles attack the leaves of the common garden or field bean and the lima but rarely other plants. The insect is a lady beetle one-quarter of an inch long, pale brown or buff, and has eight black spots on each wing cover. The larvae are a little longer, orange in color and covered with long, branched spines.

Dusting with magnesium arsenate or calcium arsenate will kill the beetle, or either of these materials may be usd as a spray. One pound of magnesium arsenate in 50 gallons of water is an effective spray. If the bean pods are to be eaten, either of these treatments is dangerous. In this case, it is advisable to spray with a pyrethrum soap preparation.

All varieties of beans commonly listed in the seedsman's catalog were grown and fed upon by the beetles in a study of the life history of the insect in Connecticut.

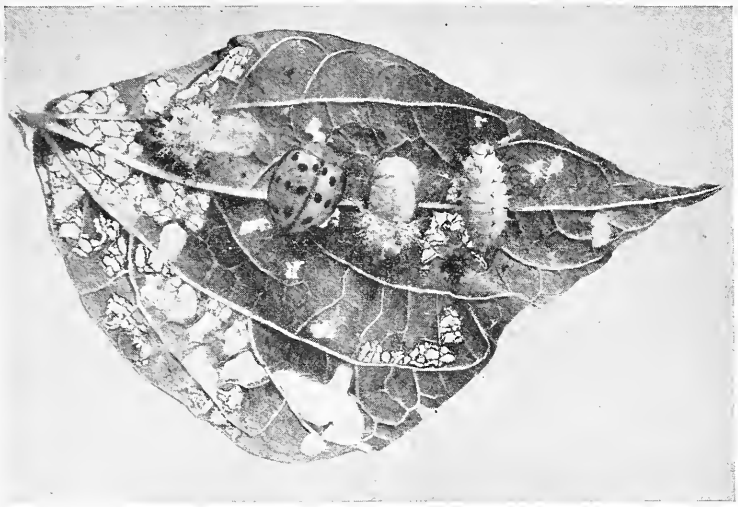

FIGURE 4. Larva, pupa, and adult of the Mexican bean beetle, *Epilachna corrupta*. They are shown on an injured bean leaf.

Satin Moth Discovered Farther West

The satin moth has continued to spread westward. Last year it was found in Burlington, Farmington, New Britain, Newington and West Hartford, and this year it was discovered in the northeastern part of Waterbury.

Territory quarantined on account of the pest includes all of that east of the Connecticut River and the towns of Hartford and Suffield, which lie west of the river. The restrictions forbid the movement of poplar and willow trees out of this part of the state.

Gipsy Moth Control Effective

Scouts who searched the woods for infestations of the gipsy moth found that spraying and creosoting had cut down the size of old infestations and checked material spread of the pest.

A few woodland colonies, which are difficult to treat, gave some trouble and apprehension. One of these was on West Peak in Meriden, a dangerous infestation because from that height moths can be blown many miles and so infest a wide area. Newly hatched caterpillars have areostatic hairs on their bodies and have been

carried more than 20 miles when wind and weather were favorable. Beseck Mountain, Middlefield, was also found infested but recent scouting in both locations reveals only a few egg-clusters.

The gipsy moth was discovered present in such large numbers in the town of Branford, scattered near the Green and bordering United States Route No. 1, that the entire town was sprayed late in May. More than a ton and a quarter of arsenate of lead was applied, and fruit as well as shade trees were treated.

Fifty-nine of the 98 infestations in Connecticut were sprayed to kill the larvae as they hatched in the spring, and scouts searched more than 150,000 acres of woodland for the egg-clusters. No defoliation occurred in this state and much less damage was seen in Massachusetts, Maine and New Hampshire than in 1929.

Spread of Japanese Beetle

The Japanese beetle was found this summer in five widely separated towns where it was not known before: Branford, Danbury, Meriden, Enfield and Terryville, of which Branford, lying just across the line from the generally infested territory of the state, has the heaviest infestation.

In Hartford, New London and Wilimantic, which were comparatively recently attacked, the pest was more numerous than in any previous year. Lawns in these towns were treated with arsenate of lead in the spring to kill the grubs, and traps were placed to catch the flying beetles. The following numbers were caught:

	No. beetles found
Hartford	3,183
New London	120
Willimantic	17
Total	3,320

Bridgeport, one of the first towns where the Japanese beetle entered Connecticut, still has the heaviest infestation. More were observed there this summer than have ever been seen before. As yet no commercial injury has been reported in any part of the state.

The principal highways leading out of the generally infested area, which extends in a strip on Long Island Sound from New Haven to Greenwich, were patrolled from April 1 to August 31.

Asiatic Beetle

The Asiatic beetle was found in July in a few places outside the quarantined area in New Haven. At the Bridgeport infestation, the soil was treated with lead arsenate and many owners in

the Westville district of New Haven, where most damage has been done, have treated their lawns with satisfactory results. The Department of Entomology has inspected lawns and advised owners as to treatment and in some instances the treatments have been personally supervised.

Oriental Peach Moth Parasites Distributed

Six million specimens of the Oriental peach moth parasite *Trichogramma minuta* were reared by the Experiment Station and distributed to 140 growers in the first year of the experiment in controlling the peach moth by parasites. About 12,000 specimens of another parasite, *Macrocentrus ancylivora,* were collected or reared and distributed; 3,000 of these were supplied by the United States Department of Agriculture.

Whereas certain Connecticut peach growers lost 80 per cent of their crop in 1929 and the injury through the state as a whole was 50 per cent, this summer the average of wormy peaches was one in ten, and the pest took only half the crop in the most heavily infested orchard in Connecticut. Reduction in injury was estimated at $100,000.

The orchard owners who contributed money toward the fund for production of the parasites under the direction of Dr. Philip Garman are much encouraged in their fight to raise peaches free of the peach moth.

The drought undoubtedly assisted in cutting down the infestation. The dry weather was unfavorable to the peach moth because it checked the growth of the young tree shoots, where the larva feeds, and it encouraged the Trichogramma. Parasites that were already in the field were also found active in combating the peach moth.

Two more incubation units have been added recently to the parasite laboratory, for which much new equipment has been purchased, and it is hoped that next year twice the number of parasites will be produced. The outlook for controlling the peach moth is even more favorable, since the infestation was so small this summer.

An intensive study of the Oriental peach moth has been under way for several years. The results so far accumulated were published by Dr. Garman as Bulletin 313.

ONE THOUSAND APIARIES INSPECTED

More than 1,000 apiaries, containing 10,303 colonies, were inspected and found to be in a generally healthy condition. American foul brood, which is the most prevalent of any bee disease, appeared in 52 colonies, slightly more than last year.

Many bee-keepers in the state fail to register each year and so may cause the spread of contagious bee diseases from hives that are unhealthy to those that are in good condition. A diseased colony can endanger all the bees in the vicinity. It is estimated that there are 15,000 colonies of bees in the state, but only 10,303 were inspected.

NURSERIES INCREASE IN NUMBER

Coincident with building the beautiful homes that now distinguish Connecticut has come a great increase in the nurseries in the state. Ten years ago only 92 nurseries were established in Connecticut. This year 302 nurseries were inspected and granted certificates by the State Entomologist. In 1929, 266 certificates were issued.

In a decade the number has grown more than three and one-fourth times, but the population has not grown proportionately. The explanation may be seen in the increased wealth of the state's residents and their deeper interest in cultivating flowers, shrubs, and other plants. The tendency is to add ornamental shrubs, evergreens and other perennials to the nurseryman's stock. Fruit trees and currant bushes do not have the preponderance they once had.

Connecticut's many nurseries on the whole maintain a high quality of plants and seedlings, fairly free from insect pests and fungi, the inspection shows.

IMPROVING CONNECTICUT WOODLANDS

Experimental Forest at Rainbow

That conifers will grow well on a light sandy soil unsuitable for other crops is demonstrated in Station experiments at the Rainbow Forest Plantations. Sufficient data has not been accumulated on other phases of this work, but eventually these same plots will show the silvicultural methods that should be applied to such stands.

Information on forestry practices in Connecticut has been accumulating on the Rainbow tract of 100 acres for almost 30 years. In 1901, when the study of forestry was just beginning in the United States, the Station laid out these elaborate experiments. White pine, red pine, Norway spruce, and mixtures of these and many other conifers were planted. Other plots were laid out with black locust and red oak, and with mixtures of these and conifers. To-day this forest stands in age and extent unique among forestry investigations in the United States.

Studies undertaken in the last 30 years involve a continued program of silvicultural treatment (including cleaning, thinning

FIGURE 5. Red pine in the Rainbow Forest Plantations.

and pruning), which is being carried out as rapidly as practicable. Several decades more are required for completion. Meanwhile

periodic measurements of trees on each plot will furnish information as to the immediate results of the treatments.

These plots also provide a laboratory for studying the relation of forest and soil, the control of insect and fungous pests, and other problems closely allied with forestry. Experiments along these lines are being undertaken in coöperation with other departments of the Station. The study of pine leaf litter and its effect on sandy soil, begun a year ago in coöperation with the Department of Soils, is an example.

In this last year a study in control of the white pine weevil was begun with the Department of Entomology. White pine seedlings were planted over an area of one acre that was already occupied by a thinned strand of gray birch. From time to time this stand will be further thinned to permit the white pine to come through, but the cover will be maintained as long as possible to determine to what extent weevil damage to the white pine will be prevented thereby. A recently acquired tract of 12 acres on which there is a heavy stand of gray birch will be used to test the practicability of growing white pine free from weevil damage, by planting the pines in openings surrounded by birch.

Influence of Soil on Forest

Studies on the rate of growth of red pines in pure plantations will soon be published. In 1930 a similar study of second growth oaks stands was attempted in the hope of finding some correlation between the height growth of dominant trees in such stands and the site factors studied in connection with red pine. It is not anticipated that the results of this study will be conclusive, but they should afford a preliminary step toward the solution of a complex problem, the relation of our native forest types to their environment.

Distribution of Forest Planting Stock

The total number of trees for forest planting distributed by the Station in 1930 was 1,508,000, which is three per cent more than the previous year. About 500,000 of these were planted on farms under the Clarke-McNary Act. This does not indicate the entire interest in forest planting in Connecticut; several of the larger water companies grow their own stock or buy it directly from commercial nurseries.

One million seedlings, mostly red pine, were transplanted last spring on land adjoining the Tobacco Substation at Windsor. The Station still has a quantity of transplants grown in coöperation with the Connecticut Agricultural College at Storrs and with

the State Forester in Simsbury, so that the total stock available for distribution to Connecticut land owners in 1931 will be about 1,250,000 coniferous trees.

Hitherto, the Station obtained most of its seedling stock from commercial nurseries, but it became necessary to undertake production of transplants in order that they may be supplied at a price low enough to encourage reforestation of idle lands.

Control of White Pine Blister Rust

Last summer's work in control of the white pine blister rust practically completed the initial eradication of currant and gooseberry bushes within infecting distance in the natural pine sections of Connecticut. The bushes, scientifically known as Ribes, were destroyed on 42,244 acres in 13 towns. It is estimated that this work protected approximately 14,500 acres of white pine.

The blister rust requires two plants for its development, the Ribes and the white pine. Protecting the tree from the disease is accomplished by destruction of the currant and gooseberry bushes within infecting distance. This is 900 feet for the commoner species of Ribes and one mile for the cultivated European black currant. Where the original eradication of Ribes was made from five to ten years ago, bushes have sprung up from parts of the root crowns left in the ground or from seeds, and there is immediate need for the area to be cleared again.

All European black currants were destroyed last summer in a house-to-house campaign in the towns of Salisbury, North Canaan, Norfolk and Colebrook. Since this species is so dangerous in its capacity to infect white pine over a great distance, statute forbids growing it in Connecticut.

In conjunction with this elimination project, a survey of cultivated Ribes was made and it was attempted to remove all such bushes within infection distance of pines. This latter effort was only partially successful; the statutes do not permit the destruction of uninfected cultivated Ribes outside of control areas. Owners of half of these cultivated bushes refused to coöperate in removing them.

Two additional nurseries have coöperated with the Experiment Station in the establishment of "sanitation zones" in order to grow white pine. The Station destroyed all Ribes within a radius of 1,500 feet around each nursery and cleared all European black currants within a mile. Sanitation zones previously declared around nine nurseries were checked this summer.

CROSSED CORN

Canada-Leaming

Seed for Canada-Leaming, the crossed corn that the Station bred to ripen before the costly early frosts of the Northeast, was offered for sale this year for the first time. The new type was planted for ensilage on many farms in northern New England and in most places it confirmed previous trials by outyielding other varieties.

In nine tests conducted by the New York College of Agriculture in nine counties of New York, Canada-Leaming produced 14.3 tons of green weight to the acre in 1929. This was more than any other corn, and it yielded 11 per cent more grain than the next highest. At the same time it ripened as early or earlier than the ensilage varieties commonly grown. Farmers who planted Canada-Leaming in Massachusetts, New Hampshire, and Maine reported it superior to other corn for ensilage.

Canada-Leaming was developed especially for the highlands of Connecticut, the other New England states, and New York, where dairying is one of the largest agricultural industries and corn for silage is a necessity. The region is one of short growing season, and corn that has withstood insect, disease and storm for three months may yet be ruined by September frosts. The new hybrid matures in 100 to 110 days and often may be cut and shocked before then.

Combined with the early ripening, Canada-Leaming has also the faculty of pushing up a tall, heavy stalk eight to nine feet high and of producing a large grain yield. The female parent was a Leaming dent and the male a Canada Yellow flint. By inbreeding the lines were purified, the undesirable qualities weeded out and the approved characteristics fixed. By crossing these, Dr. Jones obtained the extraordinary vigor and uniformity that distinguish Canada-Leaming. The dent contributed productivity and the flint contributed earliness.

Spanish Gold, An Early Sweet Corn

Spanish Gold, the first crossed sweet corn produced by the Station for market gardeners, matured several days ahead of any other sweet corn in the trials at Windsor and it ripened before other kinds in tests conducted by farmers in various parts of the state. Comparisons were made with Extra Early Golden Bantam, Golden Sunshine, Golden Market, and seven other varieties. The new cross appeared plump, rich and yellow early in the season when buyers pay 40 cents a dozen, or more, and little good corn may be had at any price. Production was generous; every stalk bore a large ear.

The line cannot weaken, for it was bred for these traits and they are genetically fixed. One parent of the cross came from the Pyrenees Mountains of Spain. That ancestor, a flint, grew near the sky on sunny slopes where spring comes late and winter comes close to summer. It was called "Cinquantino," after the Spanish word for fiftieth, on which day it was reputed to ripen. To

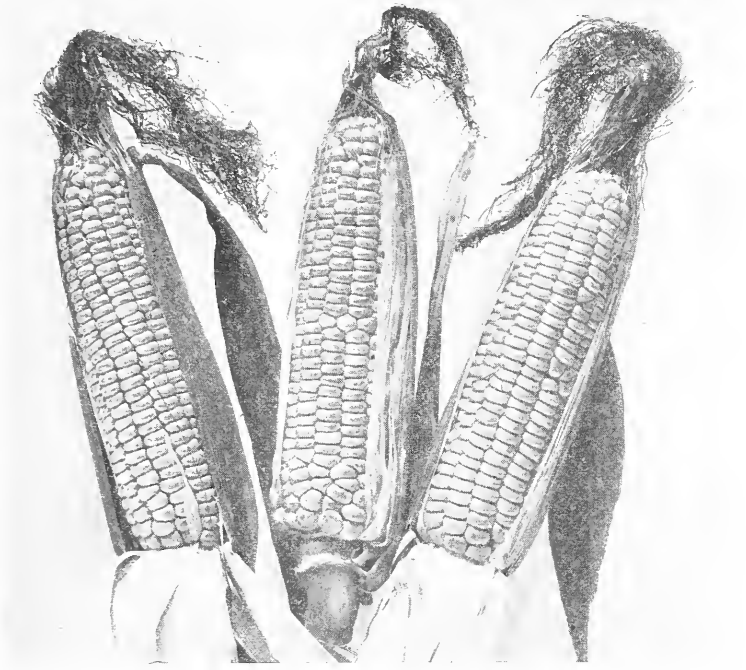

FIGURE 6. Spanish Gold, an early sweet corn developed by the Department of Plant Breeding.

obtain that earliness and vigor, the amber Spanish corn was crossed with Alpha, an early white sweet corn commonly grown in Connecticut. This Latin-Yankee union proved, like so many exotic mixtures, to foster a genius. The progeny matured remarkably early and it was good to look upon and delicious to eat. Seed for Spanish Gold will be on the market next spring.

Sweet Corn for Canning

Redgreen, a white sweet corn hybrid that matures in mid-season, is being extensively used by canners in New York State. The W. N. Clark Company of Holcomb, N. Y., planted 190 acres.

A similar cross of inbred strains of Evergreen, called Green Cross, has withstood many tests with high yields, but is still on trial in Connecticut and other states.

Hereditary Characters in Corn

Possibilities for production of certain types of crossed seed corn without the labor of detasseling are seen in a sterile tassel factor that is closely linked with endosperm color. A description of this character and its linkage relations is given in the Journal of Heredity for June, 1930. It is being introduced into the seed-parental stock of Canada-Leaming corn. After three back-crossings following the original cross, plants of the Canada flint type have been obtained that carry the tassel-sterility factor.

BERRY BREEDING

Eight thousand seedling strawberries out of Harvard 17, Chesapeake, Glen Mary and other varieties, were set out this summer in elaborate breeding studies on the Station farm at Mount Carmel. A preliminary investigation revealed that the strawberry plant responds to inbreeding and crossing in much the same way as corn. In spite of the dry weather the young plants made a good growth.

Certain strains of Cumberland black raspberry grown from self-pollinated seed have shown little reduction in bush growth or yield of fruit and at the same time are as uniform in plant and fruit as the original variety. Growing plants from seed has a distinct advantage in starting free from mosaic. The possibility of propagating these strains commercially from seed will be investigated.

NEW VEGETABLES

A new spinach developed by the Station matures early and is remarkably productive. It resulted from several years' experiment in crossing King of Denmark, Savoy and Viroflay. Several Connecticut market gardeners have grown it on trial and seed will be distributed next spring for further tests.

Seven selections of the Station's own Straightneck squash, which bears heavily and ripens early, are still under investigation. They vary in color from light to dark yellow, and are tender from end to end.

An amazing number of peppers is produced by a new pepper strain. The branches are heavy with the fruit and it matures early.

Many standard and new varieties of lettuce, tomatoes, string beans, and peppers were grown in a preliminary comparison to furnish material for breeding experiments with these vegetables.

At the Mount Carmel farm the selections that resulted from the cross of Alacrity and Bonny Best tomatoes have the desirable qualities of smooth, spherical shape, even color, and productiveness, but they are too small to be satisfactorily marketed. Further efforts will be made to increase size and hold the other qualities as far as possible.

Single plant selections of Fordhook bush lima beans are being made for desirable qualities of size and yield.

STUDYING CONNECTICUT SOILS

Fertilization of Vegetables

How to fertilize vegetables was studied on two acres of the new field station in Windsor. The following crops were grown this year:

Early
Radishes, spinach, lettuce, carrots, beets.

Midseason
Sweet corn, tomatoes, cucumbers, squash, peppers.

Late
Beets, lima beans, onions, cabbage, cauliflower, endive, spinach.

Results of one season's trial were:

In a comparison between 2,000 pounds of a 5-8-7 complete fertilizer and 40 tons of New York horse manure:

Radishes, spinach, early beets, lettuce and sweet corn were better on the fertilizer plot.
Tomatoes, squash, cucumbers, peppers, cauliflower, cabbage, endive and late spinach were better on the manure plot.

The addition of 20 tons of manure to 2,000 pounds of 5-8-7 complete fertilizer increased the yields of:

Radishes, sweet corn, squash, tomatoes, peppers, cauliflower, cabbage, endive and late spinach.

The addition of a side dressing of extra nitrogen to plots that had already received 2,000 pounds of 5-8-7 complete fertilizer broadcast at planting time:

Increased yields of early beets, sweet corn, squash and tomatoes.
Decreased yields of lettuce, cucumbers, and peppers.

A comparison between 2,000 pounds of 5-8-7 with 2,000 pounds of 5-8-12 showed that extra potash:

Increased the yields of radishes, beets, squash and peppers.
Decreased yields of lettuce (New York head).

A comparison between 2,000 pounds of 5-8-7 with 2,000 pounds of 5-5-7 showed that the use of less phosphoric acid:

> Increased the yields of radishes, early beets, peppers and onions.
> Decreased the yields of lettuce, carrots and cucumbers.

A comparison between 2,000 pounds of 5-8-7 and 800 pounds of 13-20-18 showed that the use of the high analysis fertilizer produced:

> Better yields with radishes, early spinach, lettuce and early beets.
> Poorer yields with late beets and cucumbers.

Liming, on a soil with a reaction of about 5.5 pH, produced definite increases with spinach, lettuce, late beets and cucumbers.

These results should not be regarded as conclusive, since they are based on only one year's work with a soil already in a comparatively good state of fertility. The work will be continued for several years.

Connecticut Soils Classified

With the publication of Bulletin 320, "The Soils of Connecticut," several years' work in studying the classification, distribution and use of the soils of the state has been brought to a temporary conclusion. However, this information cannot be applied in a detailed way upon individual fields and farms until a soil survey of the entire state is made, on a scale of at least two inches to the mile. Preceding this survey, aeroplane photographs or revised topographic maps will be needed to facilitate accurate mapping of the irregular and complex distribution of our varied soil types.

Fertilizer Needs Specific

Pot experiments with many different types of soil from 70 different fields in the state have justified the conclusion that fields which have not been liberally limed or fertilized in the past are almost universally deficient in lime and in readily available nitrogen, phosphoric acid and potash, while soils that have been fertilized and limed now vary greatly in their present nutrient requirements, regardless of the soil type. Consequently the needs for fertilizer and lime are an individual problem on any given field, and general recommendations of treatment are inadequate except on soils known to be in a neglected state of fertility.

Further pot experiments are now being conducted in order to show the differences in the fertilizer requirements of various crops on soils that represent typical conditions of past treatment in dairy

farming and tobacco and vegetable cropping systems. The increasing intensity of our agricultural production demands methods of soil diagnosis that will enable us to make specific fertilizer recommendations for a particular crop on a particular field, rather than a generalized formula that is developed from the results of field plot experiments with a few crops on only one or two different soils. Four methods of determining the fertilizer requirements of the soil will be compared: chemical availability tests, pot experiments of the Mitscherlich type, Neubauer tests and azotobacter tests.

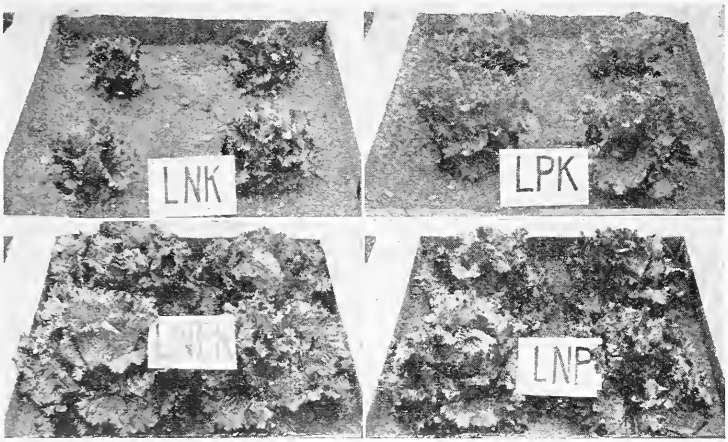

FIGURE 7. New York head lettuce grown in concrete-walled plats. LNK lacks phosphorus; LPK lacks nitrogen; LNP lacks potassium, and LNPK receives a well-balanced fertilizer.

This work is supplemented by the results of fertilizer trials on small concrete-walled soil plats under field conditions. Two sets, each containing 48 1/10,000 acre soil plats, have been giving excellent results in showing the fertilizer requirements of several important vegetable crops, while two sets of ten 1/2,000 acre plats have been constructed at Windsor.

Nitrogen Loss Revealed by Lysimeters

Heavy rains in late May and mid-June washed out of Connecticut tobacco fields more than half of the nitrogen that is applied to give a quick, healthy growth to seedling plants, and growers were advised that the crop was in danger of undernourishment.

The information was disclosed in reading the lysimeters at the Tobacco Substation in Windsor for the first month after the plants were set out. The apparatus collects water passing through the soil and chemists analyze the liquid to determine the plant food that is thus carried away from the roots.

More leaching occurred last summer in the first 30 days of tobacco field growth than in the first four months of the summer before. In 1929, which was unusually dry, the plants lost none of the quickly available nitrogen. This year they immediately lost the greater part of it.

The character of the soil is a powerful influence on the amount of plant nutrients that wash through with rain, it is shown in the first year's record of the lysimeter. The apparatus, which is built partly underground, with tubes that lead from tanks of soil treated with various fertilizer applications, was installed a year ago. It is one of the few in the United States and the only one in New England. Tests now in progress deal with tobacco, since fertilizer costs on that plant are greater in Connecticut than for other crops, but these will be studied later.

Not only does the soil affect the leaching, but it influences the rate at which plant nutrients become soluble and thus are susceptible both to being absorbed by the plant and to being washed away. In the tobacco-growing season, Enfield fine sandy loam lost less than half the nitrogen that three other soils lost, whereas Merrimac sandy loam and Merrimac coarse sand were drained quite heavily.

Twenty-three inches of rainfall were removed by the tobacco plant or evaporated from the soil in a year's time, according to lysimeter measurements. Of a total rainfall of 32 inches, only nine inches passed into drainage tanks.

Of the four forms of nitrogen tested on the various soils, nitrate of soda was the only one completely leached out in one year. Potash losses were practically independent of nitrogen treatments and were chiefly affected by the type of soil. Phosphorus was not leached except in negligible quantities.

Manure was found slow to nourish the plant and some symptoms of nitrogen starvation were seen before the end of the season on plants raised on manure alone. Heavy lime losses accompanied severe leaching of nitrogen. Such losses can be partially counteracted by the use of calcium nitrate rather than nitrate of soda.

TOBACCO INDUSTRY SERVED BY SUBSTATION AT WINDSOR

Tobacco production as an industry in Connecticut is growing year by year into closer relationship with the Tobacco Substation

in Windsor. Every summer the Substation is able to serve a greater number of growers with information on seed-beds, fertilizers, insect and fungous pests, cultural practices and curing.

Research on various phases of these problems is now underway. The complete report for the year cannot be issued until the crop is sorted and the data compiled. However, certain interesting and important results are presented here.

Rôle of the Mineral Bases in Combustion of Cigar Leaf

Although potassium has been found to be essential to a long fire-holding capacity of the leaf, there is danger of increasing this base to the exclusion of another one, magnesium, which is just as important. Too much potassium in proportion to magnesium causes fusion of the potash salts and inclusion of carbon particles that cannot be oxidized, thus producing a dark colored ash. Under these conditions of incomplete combustion, the resultant gases have an objectionable aroma and the taste is not pleasant.

However, when the proportion of magnesia is increased to about two per cent of the dry weight of tobacco, the ash is white or very light gray, indicating that combustion is complete; the coal band is narrow, and the taste and aroma are improved. Too much magnesium must be avoided, since it causes the ash to "flake." Calcium is very much less efficient than magnesium in producing these beneficial effects.

Black Rootrot Resistant Shade Tobacco

The 4R strain of shade tobacco originated at this Station, the high resistance of which has been described in previous reports, was tested more thoroughly for quality both in the shade tent on the Experiment Station farm and on the plantations of some of the shade farms. Very favorable reports from all the growers have been received. At the Substation, the sorting records showed it to be somewhat better than the ordinary strain, even in the absence of serious rootrot. The object of the tests this year was to learn whether it possessed as good commercial qualities as the commonly grown, non-resistant strain. All results up to the present indicate that the quality is at least as good as the ordinary Cuban strain.

Better Tobacco Growth with Irrigation

One of the improvements at the Tobacco Substation this year was the installation of an irrigation system consisting of a hydrant on a large water main and 700 feet of fire hose. With this it was

possible to irrigate any part of the farm. In late July, the weather became very dry and most of the fields were irrigated by running the water between the rows. Check plots were left, which received no water. Striking differences in growth resulted in favor of the irrigated plots.

FIGURE 8. Setting tobacco plants with the use of a tractor on the Tobacco Substation farm.

Tobacco Raised by Tractor

For two years all operations on the Substation farm have been performed by tractor without the use of horses. There seems to be no operation connected with the growing of tobacco that cannot be done as well or better with a tractor as with horses. Additional tractor machinery used this year were a two-row setter, Thompson attachments for hilling, and specially built racks for drawing tobacco to the shed.

Manure Not Satisfactory

On a few plots where stable manure and "Adco" artificial manure were used each year for five years to supplement the commercial fertilizer, the tobacco was very inferior and more stunted than on the adjacent plots where no manure was used. These same

manured plots were also badly stunted in 1929. Marked wilting of the leaves on hot days indicated root trouble and examination of the roots immediately after harvesting showed that black rootrot was much worse here than on unmanured plots.

A more extensive series of experiments in which cow manure is being tested as a *substitute* for varying proportions of the commercial fertilizer was begun in 1930 on a shade plantation in West Granby. In this first year the manure did not prove to be as good as commercial fertilizer. It increased neither the yield nor the quality and the percentage of the darker and heavier grades of leaves was greater. One year is not a sufficiently long time on which to base conclusions, and the tests will be continued.

Tobacco Nutrition

The fertilizer plots that occupy the larger part of the farm were continued in 1930 and additional plots on phosphorus and magnesium were begun. Final results based on the sorting records have not yet been calculated, but some observations from field growth may be recorded.

Tobacco on the plot treated with nitrate of soda as the only source of nitrogen turned yellow very quickly after the heavy rain in early June, and never made even a fair growth afterward. The sulfate of ammonia plot was very stunted, probably due to the extreme soil acidity that has developed. All other nitrogen carriers gave good growth. On a new field, which had not grown tobacco for many years, if ever, phosphorus in precipitated bone was very beneficial to growth. Ground tobacco stems used as the only source of potash gave a remarkably fine growth, fully as good as any other potash carrier or combination of carriers.

Acetic Acid for Sterilizing Seed Beds

Where the soil in seed beds was saturated with a one per cent acetic acid solution, they were entirely free from disease, as were also adjacent beds where the soil was sterilized by steam. Apparently the acetic acid did not kill all the weed seeds, since there were more here than in the steamed beds. The weeds, however, were not sufficiently numerous to cause any serious trouble.

Controlled Curing of Shade Tobacco

Two years results from the "curing chambers," where tobacco was cured under controlled conditions of temperature and humidity, indicate that these factors influence to a marked degree such characteristics as color, texture, grain and prominence of veins.

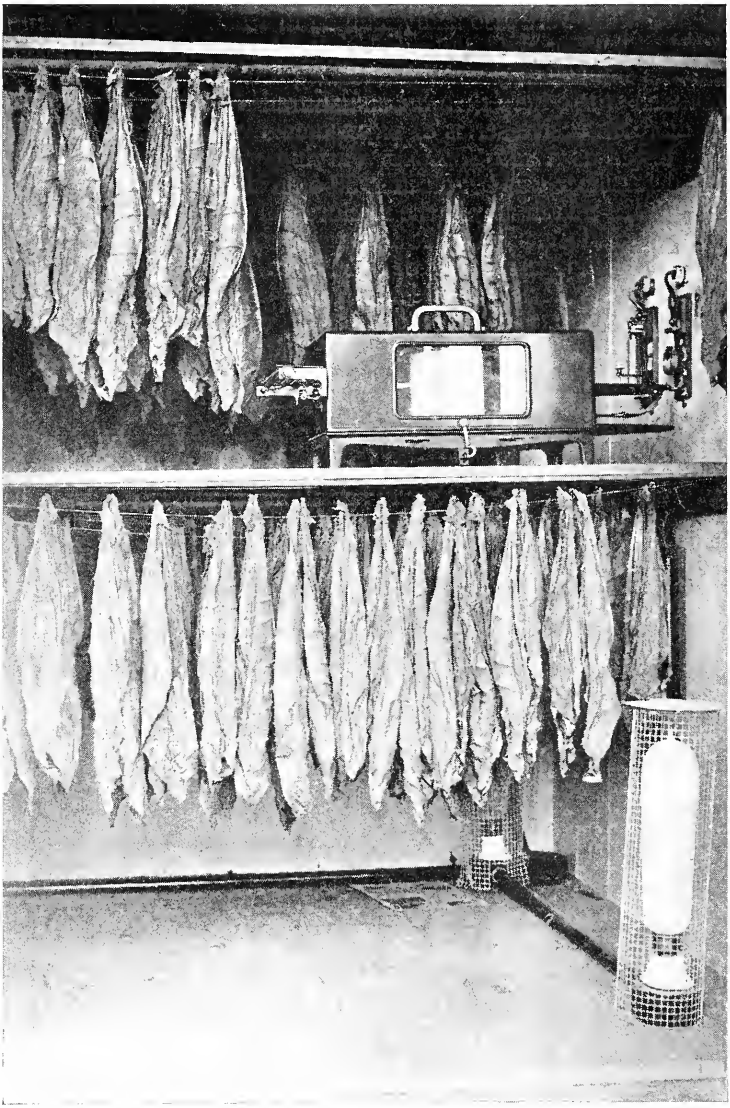

FIGURE 9. Tobacco in the "curing chambers" of the Tobacco Substation, where tobacco is cured in experiments with controlled conditions of temperature and moisture.

Relative humidities below 70 per cent and above 90 per cent are unsatisfactory, without regard to temperature, while 80 per cent to 85 per cent is the optimum for most conditions. Using the last

named humidity range, the optimum temperature for the early pickings was found to be about 95° F. and for later pickings 85° to 90° F. A temperature of 95° on fourth picking produced a deep olive-brown, the so-called "blue-black" tobacco.

NEW VEGETABLE FIELD STATION AND FOREST NURSERY

A field station to be devoted mainly to investigations for Connecticut's vegetable industry was established this spring. The land comprises seven acres adjacent to the tobacco substation in Windsor, making possible the use of equipment already on hand. Means were thus provided for a new project, an extensive study of soil fertility in relation to vegetable growing, and an expansion of the Station's experiments with vegetable breeding.

The Station now has two experimental fields in addition to the laboratories and greenhouses in New Haven. The Windsor field, with light and sandy soil (Merrimac sandy loam), in contrast to the older one in Mount Carmel (Wethersfield loam), is especially adapted to early crops. These will receive particular attention.

This summer the Station's own early sweet pepper, Straightneck squash, spinach, and sweet corn were tested on the Windsor field, and more than 15 varieties of tomatoes.

Two blocks of an acre each were laid out in fertilizer studies. On one, spinach, lettuce, carrots, beets, onions, and radishes were first grown. They were followed on the same field by later crops such as tomatoes, cauliflower, celery, and late spinach. On the other block sweet corn, tomatoes, squash, and peppers were planted.

The fertilizer treatments were applied in rows at right angles to the rows of crops. In this way information pertinent to each crop may be obtained on varying applications of manure, concentrated chemical fertilizers, "green manure" crops, lime, and such elements as magnesium, sulfur, chlorine, and manganese.

Another program made possible by the acquisition of this tract is growing forest nursery stock. A million seedling trees, mostly red pine, were set out in April on one plot of the new field. These will be distributed for forest planting next year under the Clarke-McNary Act. By this plan farmers obtain trees at cost from the Station.

DR. MENDEL APPOINTED TO STAFF

The Board of Control this spring elected Dr. Lafayette B. Mendel of Yale University to the Staff as research associate in biochemistry. He collaborated from 1908 to 1928 with the late

Dr. Thomas B. Osborne, who was in charge of the Biochemistry Department, in studies of nutrition that attained world-wide recognition.

Pioneers in their field, they fed the isolated proteins of milk, and of wheat, corn, and other seeds to white rats and established the fact that certain of these proteins are insufficient for life and growth. Among other problems they investigated the distribution of vitamins, diets that produce exceptionally rapid growth, the inorganic constituents of diets and the nutritive properties of green leaves. Since Dr. Osborne's death the work has been carried on with Dr. H. B. Vickery, who succeeded him as head of the biochemistry laboratory.

The action of the Board was taken to recognize officially the relationship that has existed for years. Dr. Mendel is Sterling professor of physiological chemistry at Yale University and chairman of the department of physiology and physiological chemistry.

FIFTY YEARS' INDEX PUBLISHED

An index to the publications of the Station for almost its entire existence, was published this year. It is the "Fifty Years' Index, 1877-1927," Bulletin 309, compiled by Dr. E. H. Jenkins, Director Emeritus.

Dr. Jenkins has been a member of the Station Staff for the entire period covered by the material he has gathered together. Coming to the Station in 1876 after a year of graduate study in agricultural chemistry in Leipzig, he served as chemist, vice-director and director, being appointed to the highest post in 1900 on the retirement of Prof. Samuel W. Johnson. In 1923, after 48 years of active work, Dr. Jenkins was made Director Emeritus. He now lives at 108 East Rock Road, New Haven.

Many of the changes that have remade Connecticut agriculture in the last half-century can be traced to the publications notated in this index of 50 years' work. Founded in 1875, this Station was the first in the United States and it antedated by several years the general movement for agricultural research in this country. Many of its experiments were on subjects that had never before been investigated, and the index is of scientific value the world over.

STAFF MEMBERS HONORED

Several members of the Station Staff were honored during the year by scientific societies and institutions of learning. Dr. George P. Clinton, Botanist, was made a member of the National Academy of Sciences, one of the greatest honors that can be conferred on an American scientist. He is an authority on the

smut diseases of plants, in which his particular interest lies, but he has done notable work with rusts and many other diseases of plants. He has investigated and written on the potato blight, the chestnut blight, mosaic diseases, especially of tobacco, downy mildew of lima beans, the white pine blister rust, the willow scab fungus and other pests as they appeared in Connecticut.

Dr. W. E. Britton, State and Station Entomologist, received the honorary degree of Doctor of Science from the University of New Hampshire, his Alma Mater. The citation in part said, "Your steady progress in the great science to which you have given your life—the science that protects the crops of the farmer and makes safe the food supply of the nation—has been rewarded during the years by many and marked honors. You have served one state for almost four decades, but your influence has gone far beyond its borders. Your devoted labors have won for you international reputation in your profession, a reputation of which your Alma Mater is justly proud."

Rutgers University conferred the honorary degree of Doctor of Science on Dr. Lafayette B. Mendel, research associate in biochemistry. The occasion was the New Jersey Agricultural Experiment Station's celebration of its fiftieth anniversary. Dr. Mendel was cited as, "Teacher and investigator in physiological chemistry and nutrition at Yale University, his Alma Mater, for nearly 40 years; research associate of the Carnegie Institution, who, while associated with the late Thomas Burr Osborne at the Connecticut Agricultural Experiment Station, was among the first successfully to use small experimental animals in the study of the nutritive value of proteins and other foodstuffs and to demonstrate the existence of the vitamins."

Dr. E. M. Bailey, in charge of the Department of Analytical Chemistry, served this year as president of the Association of Official Agricultural Chemists. He is widely known as an authority on the analysis of foods and drugs. Last spring he was appointed a member of the Council on Pharmacy and Chemistry of the American Medical Association. He has served for years on the Food Standards Committee of the United States Department of Agriculture and the committee of referees of the Association of Official Agricultural Chemists.

FIELD DAY AT MOUNT CARMEL FARM

More than 500 Connecticut farmers and their families attended the 19th annual Field Day August 20 on the experiment farm in Mount Carmel, south of Sleeping Giant Mountain. The visitors were enthusiastic and keenly interested. They made the yearly exhibit one of the most successful in the Station's history.

The corn borer, the Japanese beetle and the Oriental peach moth were the principal exhibits of the day. Against the first two of these pests, the Station and the United States Department of Agriculture maintain quarantine in Connecticut; the other has a severe infestation in the state and in 1929 caused damage estimated at more than $200,000.

H. N. Bartley and C. H. Hadley, federal agents in corn borer and Japanese beetle control, discussed these insects. Dr. Philip Garman, in charge of Oriental peach moth investigations and parasite-rearing at the experiment station, talked about the peach

FIGURE 10. Field Day on the experiment farm in Mount Carmel.

moth and how to cut down damage in Connecticut. Tall stalks of Canada-Leaming, the Station's early and prolific crossed corn for silage, were plowed underground as a demonstration of corn borer control. Exhibits showed the life history and habits of the pests.

Corn, vegetable and berry breeding, woodlot control, fertilizer studies and insect and fungous control were shown on various fields of the farm.

A kindergarten with a teacher in charge was maintained for the younger children. Most of the families came in the morning and stayed for the speeches and plowing demonstration in the afternoon. Lunch was eaten at noon under the big tent.

CHANGES IN STAFF

Appointments

A. A. Dunlap, Ph.D., Assistant Mycologist, July 15, 1930.
Lawrence C. Curtis, B.S., Assistant in Plant Breeding, August 1, 1930.

Resignations

H. R. Murray, M.Sc., Assistant in Plant Breeding, June 1, 1930.
Harold B. Bender, B.S., Assistant in Botany, July 1, 1930.
Henry Bull, M.F., Assistant in Forestry, October 1, 1930.

PROJECTS FOR 1930-1931

Analytical Chemistry

1. Inspection of fertilizers.
2. Inspection of feeding stuffs.
3. Inspection of foods and drugs.
4. Calibration of Babcock glassware and thermometers.
5. Analyses of insecticides and fungicides.
7. Analyses of special and miscellaneous foods.
8. Collaborative studies on analytical methods.

Biochemistry

1. Cell chemistry.
   a. A detailed examination of the nitrogenous constituents of plant cells, in particular those of leaf tissues. The further development of methods for the determination of the different forms of nitrogen in extracts of such tissues.
   b. An investigation of the nitrogenous constituents of the tobacco plant with special reference to the changes that occur during curing.
   c. An investigation of the composition of tobacco seed.
2. Protein chemistry.
   a. The methods for the determination of the basic amino acids yielded by proteins with the object of increasing their accuracy and convenience.
   b. The methods for the separation of other amino acids yielded by proteins.
   c. The properties of certain of the amino acids and their derivatives.
   d. Methods for the preparation of pure proteins on a large scale with the object of obtaining material for chemical and nutritional study.
   e. Methods for the preparation of the proteins of the tobacco seed.
   f. The properties of the globulin of the tobacco seed.
3. Nutrition investigations.
   a. The relation of diet to the rate of growth with especial attention to certain factors that appear to determine rapid growth.

b. The investigation of the relation of certain constituents of the diet to the growth of skeletal tissue.
c. The relation of rate of growth to well-being as shown by the investigation of certain organs and tissues.
d. The relation of the rate at which growth has occurred to the basal metabolism of the rat.
e. The investigation of the nutritive properties of the tobacco seed.

Botany

2. The nature and cause of mosaic disease of plants.
5. Plant disease survey of Connecticut.
6. Study of the perfect stage of *Thielavia basicola.*
8. Spraying and dusting experiments on apples and peaches. (See also Entomology, No. 3.)
15. A study of the virulence of the chestnut blight.
16 Tobacco diseases, especially black and brown rootrot.
20. Diseases of shade trees.
23. Rogueing as a control for raspberry mosaic. (With U. S. Dept. Agr.)
24. Studies of the morphology of the willow scab fungus.
26. Tests of various materials for soil treatment in control of dampening-off of vegetable seedlings.
27. An investigation of an elm disease in Connecticut.
28. Studies on the identification of apple varieties by seed characters.

Control and Service

12. Seed testing.
25. Determination of the discharge of ascospores of the apple scab.

Entomology

3. Spraying and dusting experiments on apples and peaches. (See also Botany, No. 8.)
6. Control of foul brood of bees.
9. Insect survey of Connecticut.
16. Experiments with the cabbage maggot.
17. Studies in the control of the Oriental fruit moth.
18. Life history of the imported currant worm.
20. Life history, habits and control of the birch leaf-miner, *Fenusa pumila.*
26. Experiments on the control of the squash vine borer.
28. Investigations on oil sprays.
29. Life history of the Mexican bean beetle in Connecticut.
30. A study of insects that attack the tobacco plant. (See also Tobacco Substation, No. 20.)

Control and Service

10. Inspection of orchards and nurseries.
11. Control of gipsy moth. (In coöperation with U. S. Dept. Agr.)

12. Elimination of the mosquito nuisance.
13. Inspection of apiaries.
19. Control of the European corn borer. (In coöperation with U. S. Dept. Agr.)
24. Control of the Asiatic beetle.
25. Control of the Japanese beetle. (In coöperation with U. S. Dept. Agr.)
27. Rearing and distributing parasites of the Oriental fruit moth.

Forestry

1. Experimental plantations on a sandy tract at Rainbow.
   a. Comparison of many species of conifers and hardwoods, in pure stands and in combinations.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
2. Effect of thinning in white pine at Shaker Station.
3. Effect of thinning in hardwoods at Quassipaug Lake.
6. Studies of forest plantations throughout the state.
   a. Comparative growth of various species.
   b. Reasons for success or failure.
   c. Soil and other site factors necessary for success of each species.
10. An investigation of the distribution and growth of forest trees as influenced by soil conditions and other site factors.
11. Coniferous seed bed study to determine:
   a. The value of fertilizers in seed beds.
   b. The value of different amounts of seed.
   c. The value of dusts and sprays in preventing dampening off.
12. A study of preservative treatments of native woods.

Control and Service

5. Distribution of forest planting stock. (Under Clarke-McNary Act.)
7. Control of white pine blister. (With U. S. Dept. Agr.)

Genetics (Plant Breeding)

1. A genetic study of hereditary characters in corn involving their linkage relations and variability.
2. The effects of inbreeding and crossing upon corn.
3. Methods for the improvement of naturally cross-fertilized plants by selection in self-fertilized lines, with particular attention to field corn for grain and ensilage; alfalfa; some of the more important vegetable crops, such as sweet corn for market gardening and canning, beets, carrots, cucumbers, melons, squash, and some fruits, such as bush fruits and strawberries.
4. Methods for the improvement of naturally self-fertilized plants, with particular attention to tobacco and vegetable crops such as lettuce, lima beans and tomatoes.
5. A study of variation and the effects of selection in strains of cross-fertilized and self-fertilized vegetables.

Soils

1. A descriptive inventory of Connecticut soil types in relation to their use for crops, pasture and forest.
2. The physical and chemical characteristics of important soil types in relation to the nutritive response of tobacco and other crops when these soils are variously treated in the greenhouse.
3. Nutrient requirements of vegetable crops on important soil types used for market gardening in the state.
4. A study of the physical, chemical and biological conditions of several soil types in natural mixed hardwoods and in planted coniferous forests.
5. Lysimeter studies of the drainage losses and other changes that occur in several soils under heavy fertilization as practiced for tobacco and vegetables.

Tobacco Substation

1. Fertilizer experiments—various sources and rates of nitrogen, phosphoric acid and potash.
2. Field tests with farm manure.
3. Field tests with manure substitutes.
4. Tobacco nutrition studies—the rôle of nitrogen, sulfur, chlorine, potassium, calcium, manganese, boron and magnesium.
5. Improvement of Havana seed tobacco.
6. Improvement of Broadleaf tobacco.
7. Improvement of Cuban shade tobacco.
8. The effect of various winter cover crops used on tobacco land.
9. Brown rootrot of tobacco. (With U. S. Dept. Agr.)
10. Studies of black rootrot of tobacco.
11. Soil reaction in relation to tobacco.
13. Preservative treatment of shade tent poles. (See Forestry, No. 12.)
15. Topping and suckering experiments.
17. The rôle of humidity and temperature in curing tobacco.
20. A study of insects that attack the tobacco plant. (See also Entomology, No. 30.)

PUBLICATIONS

Bulletins of the Station

Report on Commercial Fertilizers for 1929. E. M. Bailey. No. 308.

Fifty Years' Index, 1877-1927. E. H. Jenkins No. 309.

Canada-Leaming Corn. Donald F. Jones and W. Ralph Singleton. No. 310.

Tobacco Substation at Windsor, Report for 1929. P. J. Anderson, T. R. Swanback, O. E. Street and Others. No. 311.

Thomas B. Osborne, A Memorial. No. 312.

The Oriental Peach Moth in Connecticut. Philip Garman. No. 313.

White Pine Blister Rust Control in Connecticut. J. E. Riley, Jr. No. 314.

TWENTY-NINTH REPORT, CONNECTICUT STATE ENTOMOLOGIST. W. E. Britton, Ph.D. No. 315.

REPORT ON INSPECTION COMMERCIAL FEEDING STUFFS, 1929. E. M. Bailey. No. 317.

REPORT OF THE DIRECTOR, 1929. W. L. Slate. No. 318.

REPORT ON FOOD AND DRUG PRODUCTS, 1929. E. M. Bailey. No. 319.

THE SOILS OF CONNECTICUT. M. F. Morgan. No. 320.

Circulars of the Station

The European Corn Borer Quarantine and Clean-Up Regulations. No. 68.

European Black Currants Outlawed. No. 69.

Nursery Sanitation Zones. No. 70.

Regulations Concerning the Transportation of Nursery Stock in the United States and Canada. No. 71.

Quarantine Regulations Affecting the Transportation of Nursery Stock in Connecticut. No. 72.

Journal Papers

BRITTON, W. E. Report of committee on injurious insects. Proc. 39th Annual Meeting Conn. Pom. Soc. 34. 1929.

———— ————. Present status of the leopard moth, *Zeuzera pyrina* Linn., in the United States. Trans. Fourth Internat. Cong. of Ent., **2**: 286. 1930.

———— ————. Insects injuring vegetable crops in 1929. Report of Com. Conn. Veg. Growers Assoc. 48-51. 1930.

———— ————. The leopard moth. Proc. Fifth Nat. Shade Tree Confr. 75.

———— ————. The larch case-bearer. Proc. Fifth Nat. Shade Tree Confr. 68.

———— ————. Better care of shade trees. Tree Talk, **100**. 1930.

———— ————. Stone quarries of Connecticut. Dir. of the Rock Prod. Ind., **45**. 1930.

———— ————. The mosquito problem of Connecticut and how to solve it. (Revised edition.) State Dept. of Health. 1930.

VICKERY, HUBERT BRADFORD. Some aspects of the chemistry of green leaf cells. Scientific Monthly, **31**: 408-421. 1930.

———— ———— ————, and PUCHER, GEORGE W. Determination of nitrate nitrogen in tobacco. Ind. and Engr. Chem., Analytical Ed., **1**: 121-123.

———— ———— ————, and BLOCK, RICHARD J. The basic amino acids of wool. Jour. Biol. Chem., **86**: 107-111. 1930.

———— ———— ————, and LEAVENWORTH, CHARLES S. The behavior of cystine with silver salts. Jour. Biol. Chem., **86**: 129-143. 1930.

MORGAN, M. F. A simple spot-plate test for nitrate nitrogen in soil and other extracts. Science, **71**: 343-344. 1930.

———— ————. Factors affecting the estimation of lime requirement from pH values. Soil Science, **29**: 163-180. 1930.

———— ————. Forest soil investigations in Connecticut. Amer. Soil Survey Assoc., Bull. **11**: 108-114. 1930.

FRIEND, R. B. The Asiatic beetle. Monthly Bul. Calif. Dept. of Agric., **19**: 220. 1930.

———— ————. The spruce gall aphids. Proc. Fifth Nat. Shade Tree Confr. 65.

GARMAN, PHILIP. Parasites for the Oriental peach moth. Proc. 39th Annual meeting Conn. Pom. Soc. 39. 1929.

———— ————. Oil sprays in the East. Amer. Fruit Growers' Mag., 50: 5. 1930.

MENDEL, LAFAYETTE B., and VICKERY, HUBERT BRADFORD. Effect of continued administration of iodide on the growth of the albino rat. Proc. Soc. Exp. Biol. and Med., 27: 806-809. 1930.

———— ————, ———— ————. The vitamins of water cress (*Nasturtium officinale*). Jour. Home Econ., 22: 581-587. 1930.

TURNER, NEELY. The place of oil sprays in Connecticut orchards. Proc. 39th Annual Meeting Conn. Pom. Soc. 79. 1929.

———— ————. Scientific experimentation and spray problems. Proc. Fifth Nat. Shade Tree Confr. 45.

STODDARD, ERNEST M. Report of New Fruits Committee. Proc. 39th Annual Meeting Conn. Pom. Soc. 72. 1929.

———— ————. Report of Fruit Disease Committee. Proc. 39th Annual Meeting Conn. Pom. Soc. 80. 1929.

BOTSFORD, R. C. Anti-mosquito work in Connecticut in 1929. Proc. 17th Annual Meeting N. J. Mosquito Exterm. Assoc. 145. 1930.

FISHER, H. J., and BAILEY, E. M. Vitamin color reactions—a review of the literature. Jour. Assoc. Off. Agr. Chemists, 13, 3: 352-363. 1930.

HORST, KATHRYN, MENDEL, LAFAYETTE B., and BENEDICT, FRANCIS G. The metabolism of the albino rat during prolonged fasting at two different environmental temperatures. Jour. Nutr., 3: 177-200. 1930.

PUCHER, GEORGE W., LEAVENWORTH, CHARLES S., and VICKERY, HUBERT BRADFORD. Determination of total nitrogen of plant extracts in presence of nitrates. Jour. of Ind. and Engr. Chem., Analyt. Ed., 2: 191-193. 1930.

ZAPPE, M. P. Observations on the use of iron sulfate in Connecticut orchards. Proc. 39th Annual Meeting Conn. Pom. Soc. 106. 1929.